Research

FOR FARMERS

FALL — 1959

Nature's Pesticides

Baby Pig Anaemia

How Much Do We Know About Plant Viruses?

La Carence de Bore

CANADA DEPARTMENT OF AGRICULTURE

Research FOR FARMERS

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Ottawa, Ontario

HON. DOUGLAS S. HARKNESS, *Minister*
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NOTES AND COMMENTS

Time of cutting has more than a little influence on the yield and quality of forage. The trick is to find when the greatest quantity of the best quality can be harvested. In a test at Ottawa during the past summer, first-cut production of dry matter from pure stands of timothy, brome, orchard grass and alfalfa was more than doubled by delaying the cutting date for two weeks. Although a second cut taken a month after the first one gave a much higher yield for the early-cut plot, total yield for the two cuttings showed a definite advantage in favor of delayed cutting. Between the early and later dates of first cutting, percentage of dry matter increased only slightly so that increased bulk was chiefly responsible for the overall gain in dry-matter production.

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It's no longer news that some of the best insecticides are losing their effectiveness because of the development of resistant strains of insects. From widely separated areas it has been reported that DDT, once regarded as a specific for codling moth control in apple orchards, now fails to hold this pest in check because of the rapid build-up of resistant strains. Fortunately the chemists are ready with new chemicals that for the present at least are effective, but it may be only a matter of time before they in turn will have to be replaced. Meanwhile, some attention is being focused on the possibility of utilizing naturally occurring pesticides in place of synthetics from the chemical laboratory. In his article on page 3 Dr. Martin discusses this interesting development and hints that chemicals produced within the crop itself may some day control the pests that prey upon it.

* * *

Few will question the necessity for research. We must keep up with our research program if we are to be ready to meet the constant challenge of progress. But it is sometimes suggested that we would be better advised to concentrate on the application of what we already know. Many a farmer will admit that he does not farm as well as he knows how to. A case in point is the control of anemia in baby pigs, dealt with by Dr. Gwatkin in this issue. Here is a disorder that yearly takes a heavy toll but can be readily controlled by applying simple remedies well within the reach of every farmer. And this has been common knowledge for many years. While we press forward with our research we should not lose sight of our obligation to make known through every available means, the knowledge we have already gained.

FALL—1959

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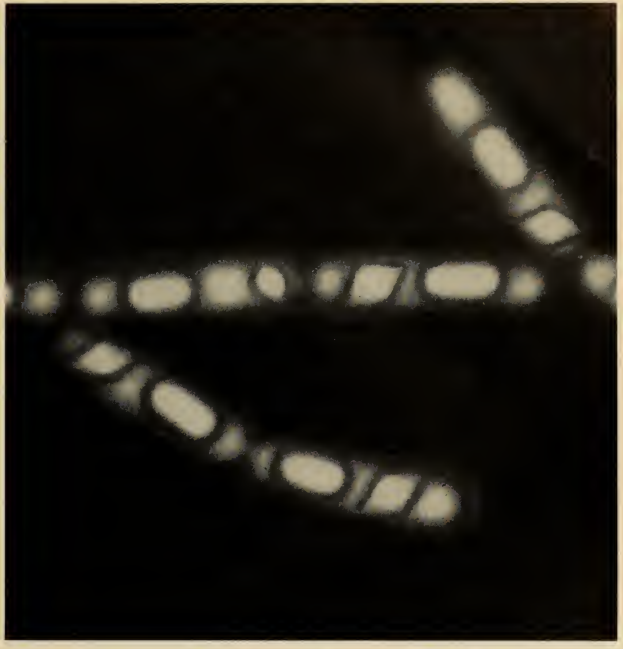
Cover Photo—Scientist using haemoglobinometer to detect presence of anaemia, compares blood from baby pigs with a known standard to determine the percentage of haemoglobin in the blood. *(See story p. 5).*

Nature's Pesticides

Hubert Martin



Bacillus thuringiensis. **A light microphotograph showing the crystalline insecticide adjacent to the spore of each bacillus.**

THE ugly but useful word pesticide brings to mind a long list of chemicals made by the synthetic chemist and sold, in a bewildering variety of formulations and trade names, to the grower who applies them as sprays or dusts to his soil and crops. He is less well acquainted with the many biologically active chemicals produced within his soil and crops—chemicals that are involved in the interplay of the complicated community of weeds, insects, and microorganisms that accompany the crop in the field. This ignorance is pardonable for only recently has attention been drawn to the possibilities of these chemicals in disease and pest control. Prospects of their use for such purposes are, with a few exceptions, still remote; but the man-made pesticide, once its hazards to health are known, is available immediately. Obviously then the plant pathologist and the entomologist, anxious to help the grower control the pests and diseases of his crops, first tries out the synthetic pesticide. Only when he has provided the grower with relief control measures can he turn to the deeper problems of why a particular insect should be a pest or by what means a fungus produces disease in its host plant.

Why a particular insect should be a pest or by what means the fungus produces disease in its host plant —these are the deeper problems being probed at the Pesticide Research Institute . . . for among Nature's potential pesticides are those chemicals that enable the fungus to produce disease and the insect to become a pest.

A fungus, being without chlorophyll, must derive the energy that it requires to live from organic matter, generally in the form of dead plant residues. Most soil fungi are such soil saprophytes but among them some have the ability to produce chemical compounds that kill living plant tissues, enabling them to cause disease. The root rot of barley produced by *Helminthosporium sativum* is an example. At the Department's Pesticide Research Institute it has been shown that this fungus kills the roots of the barley seedling in advance of its attack; and although the toxin responsible has been isolated, it has not yet been identified. This toxin not only kills roots of grasses and cereals other than barley, it also hinders the growth of many soil fungi, but not that of its parent. Yet the fungus does not have matters all its own way; the young barley seedling (and also, probably, the other grasses injured by the toxin) has its defences, for not until it is six days old does it succumb to root rot. The fungicide produced

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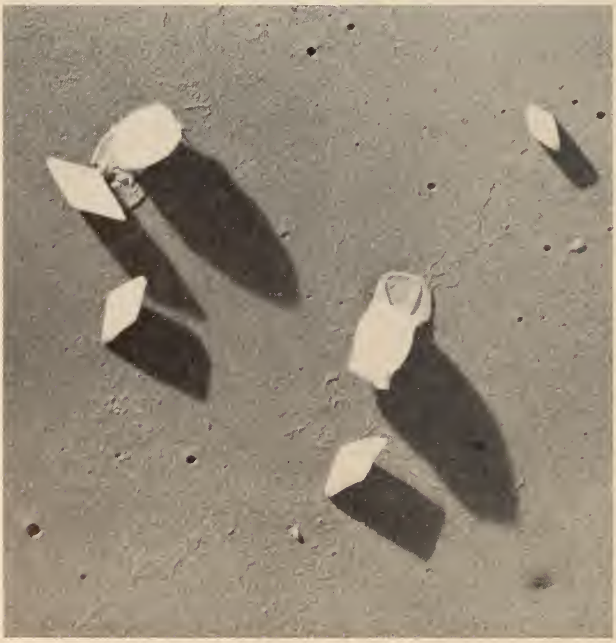
Dr. Martin is Director, Pesticide Research Institute, located on the campus of the University of Western Ontario, London, Ont.

by the barley seedling has been isolated; and it appears that the susceptibility of the six-day-old plant is due, not to the disappearance of this chemical, but to the appearance of another agent, apparently the calcium ion, which counters the ability of the seedling to resist the attack of the fungus.

It is now thought that all fungi able to attack plants work through the agency of a toxic chemical. In the words of a prominent Swiss phytopathologist: "Microorganisms responsible for disease act by virtue of the toxins they produce". Several of these phytotoxins have been isolated and characterized, one of the best known being gibberellic acid. This compound is produced by a fungus which attacks rice seedlings causing them, if not too severely infected, to grow abnormally high. Practical interest in gibberellic acid centers on its pronounced effect on crops other than rice, for example it promotes the growth of the internodes particularly in crop varieties of dwarf habit.

The ability of many soil microorganisms to produce biologically-active compounds when grown on artificial media is well known, for this provides the source of most of the antibiotics, such as penicillin and streptomycin. These compounds, being of low toxicity to man, now find widespread medicinal use. It has taken a long time to find direct evidence of the production of such antibiotics in normal soils, but circumstantial evidence is as old as the practice of the partial sterilization of soil. At the Pesticide Research Institute it has been found that the well-known soil fungicide thiram has a similar action. This fungicide is not very active against a number of soil inhabitants and is itself fairly quickly decomposed in the soil. But fungicidal properties persist and these are due not to thiram but to antibiotics such as gliotoxin produced by certain soil fungi and actinomycetes which are resistant to thiram. The prolonged control of damping-off given by thiram treatment is in a sense a biological control for it has partially sterilized the soil, permitting the antibiotic-producing soil organisms to suppress the growth of the pathogens responsible for damping-off.

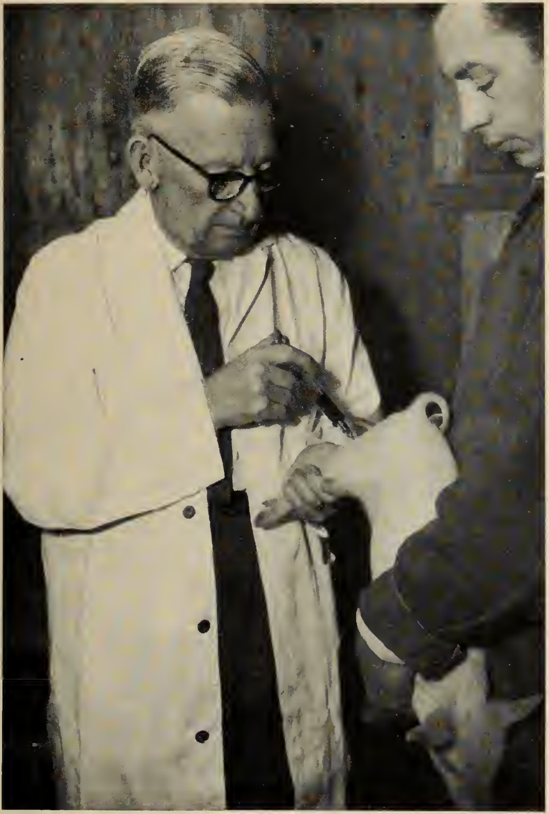
Bacillus thuringiensis. An electron micrograph of the shadowed insecticide, crystals and spores freed from the bacillus.



The chemical basis for biological control has lately been revealed in the case of *Bacillus thuringiensis* and related bacteria which have, from time to time, been employed to produce disease in certain harmful insects. The Spring 1959 issue of *Research for Farmers* reported the industrial development of a microbial insecticide from this bacillus. The main insecticide present is a crystalline protein first discovered at the Pesticide Reseach Institute. But since methods for the synthesis of this protein are unknown, and in any case would be extremely costly, the bacillus itself is employed as the insecticide.

Among the prospects of insect control by the use of chemicals produced within the crop are those arising from knowledge of the mechanisms by which the insect selects and attacks its host plant. These mechanisms are at least three-fold. First is the component of the plant that attracts the insect. Recent Japanese work has shown that the silkworm is attracted to mulberry leaves by a hexanol present in the leaves. It is stimulated to bite the leaf by a second chemical, and to continue to feed by yet a third chemical. Neither of the two latter compounds has yet been identified, but by using leaf extracts the silkworms can be persuaded to continue to eat paper. The metamorphosis of the insect larva to the pupa is known to be controlled by chemicals produced within the glands of the insect. It has been shown at Harvard that another insect hormone, when applied to the pupa, prevents its development to the mature insect.

These few examples are enough to reveal the possibilities of employing, for practical control along with man-made pesticides, chemicals already operating in the crop environment. Among Nature's potential pesticides are those chemicals that enable the fungus to produce disease and the insect to become a pest.



Author injecting iron in the deep muscles of the hind leg of a baby pig. The needle may be inserted from the back of the leg as shown or from the side (see page 6).

Baby Pig Anaemia

Animal Diseases Research Institute Specialist Reveals Results of Some Experimental Work on An All Too Common Disease of Baby Pigs Due to Deficiency of Iron.

Ronald Gwatkin

RESULTS of baby pig anaemia are so serious and the prevention of anaemia is so simple, that this disease should now be of no more than historical interest. Nevertheless, through neglect of simple precautionary measures, iron-deficiency anaemia is extremely common. It continues to take a heavy toll of suckling pigs and, indirectly, causes other troubles in older pigs.

Feeding iron to the sow from birth to her first farrowing does not increase the iron reserve in her litter. Baby pigs must accordingly have their haemoglobin level maintained by the use of iron shortly after birth because this level falls very quickly. Death from anaemia has occurred in shut-in pigs as early as 10 days of age. Pigs raised outside with access to earth containing sufficient iron do not usually show symptoms of anaemia provided their intake of earth proves sufficient to supply the needed iron. Too much reliance should not be placed on this, however, because in our experiments we have shown that severe anaemia can develop in pigs that have to depend on earth as a source of iron.

Affected litters appear healthy and active at birth and there is no reason to suppose that they are not. If not given iron they usually remain healthy for about two weeks, when some begin to show a pallor of the skin, especially on the snout and around the hooves. This is in contrast to the pink color of a healthy pig. Puffiness often develops around the eyes. When affected animals try to run about or play, they stop suddenly in an exhausted state, breathe rapidly and deeply and may make a thumping sound. This results from an insufficient oxygen supply caused by the reduced oxygen-carrying power of the blood. Frequently the largest animals are affected first because they have a greater need of iron for their faster growth.

Many piglets die from uncomplicated anaemia in the first few weeks and the survivors lose their plump, smooth appearance; fail to make proper growth; and are rough and stunted. Death often results from secondary infections that creep in, or from heavy parasitism with roundworms to which anaemic pigs are more susceptible than are normal ones.

Losses are variable, running from none to as high as 60 per cent in some litters, depending on the severity of the anaemia and on the degree of exposure to other

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Upper: **Collecting blood from the ear in a red blood cell pipette in order to count the number of red cells in a given quantity of blood.** ***Lower:*** **Filling the counting chamber with diluted blood from the pipette shown above.**

conditions. Most researchers agree that sub-clinical or undetected anaemia may play a part in reducing the resistance of the pigs to later infections.

Post-Mortem Findings

In uncomplicated anaemia, that is in cases in which death is due to anaemia itself and not to some secondary infection, the heart is enlarged and the pericardial sac may be distended with a clear jelly-like substance; the liver is swollen and pale; the spleen is enlarged and firm; the blood thin, even to the point of resembling red ink; and there is often a quantity of clear fluid in the body cavities.

The presence of anaemia can be readily confirmed by examining blood from the living subject with a haemoglobinometer, which determines the amount of haemoglobin. At birth, pigs have from 8 to 12 grams of haemoglobin per 100 ml. of blood but shortly before death from iron deficiency anaemia this may have fallen as low as 2 to 3 grams. In our experimental work carried on at the Animal Diseases Research Institute, the haemoglobin test is only one of the methods employed. In addition, counts are made of red and white blood cells, and differential counts of the various types of white cells. The volume of packed cells in a given amount of blood is also estimated. However, for practical purposes the haemoglobin test is sufficient.

Treatment

Anaemic pigs respond rather poorly to treatment and are slow to catch up to the haemoglobin levels of healthy pigs. During the treatment period they are less resistant to other troubles so that prevention of the anaemia is of much greater importance than treatment. Treatment consists of giving somewhat larger and more frequent doses of iron than need be used in prevention.

Prevention

There are on the market many iron preparations which can be given by mouth or injected into the muscles. It has been shown that 0.3 gram of reduced iron—about as much as lies on a dime—prevents anaemia fairly well if given once a week until the pigs are on solid food. The first dose should be administered on the second or third day of age. It can be given easily and quickly by placing the dose on the back of the tongue with the handle of a teaspoon.

Injectable iron is also available and, in our experiments, has given better results than the reduced iron. The injections are given in the muscles of the hind leg. Two intramuscular injections contain-

Making an injection of iron from

ing 100 milligrams of iron each will usually maintain a satisfactory haemoglobin level. The first should be given not later than the third day and the second injection 10 days later. Reliance should not be placed on one injection. Although in some cases it is sufficient, in others there is a marked decline in haemoglobin.

There have been complaints that injected legs were still stained with iron some time after injection. Injectable iron preparations are not immediately absorbed but, with the five commercial preparations used in recent experiments, there was no visible change in the meat when the legs were examined by slicing them very thinly 6 to 8 weeks after injection. It is hard to imagine that there could be any trace of iron at slaughter age if the injections are given, as they should be, before the pigs are two weeks old.

During our experiments we have encountered trouble in only one litter, and this was of a transitory nature. Some pigs in this litter had convulsive seizures following the intra-muscular injection of a product containing 150 milligrams of iron in the 2 cc. dose. The bottle was a partially used one so a fresh bottle was tried on the remaining pigs, some of which also developed convulsions. The pigs recovered in a few minutes and showed no further trouble at any time. We were unable to determine the cause, and the trouble did not appear in any other litters.

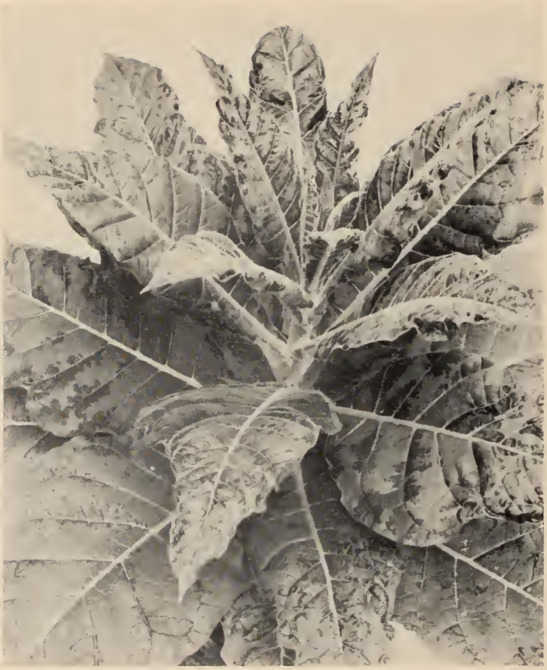
of the leg (see page 5 also).

Making a differential count of white blood cells to determine the relative numbers of the various types.

Discoloration of the skin following injection will not occur if the preparation is injected to a proper depth and the skin drawn down when the needle is inserted so that it moves back and covers the hole in the muscle. We use a 1½ inch 20-gauge needle inserted to its full length and have never encountered any surface discoloration because if properly injected there will be no leak-back.

Consideration should be given to the nature of any injectable product to be administered for the prevention of anaemia. The choice depends upon the use for which it is intended. Preparations containing vitamins and small quantities of iron no doubt have their place, but for the prevention of baby pig anaemia in normal pigs a straight iron preparation containing not less than 100 milligrams of iron should be used.

The proper dose of iron may be expected to give the desired results but overdosage must be avoided. While there appears to be a good degree of tolerance to iron in pigs, it has been shown that excessive doses cause trouble; therefore it is important to keep to the prescribed dosage.



Tobacco plant infected with tobacco mosaic virus.

How Much Do We Know About Plant Viruses?

The author discusses some plant diseases caused by viruses and how these diseases spread. He also points out that chemical studies of the virus particles offer exciting possibilities of increasing our knowledge of these minute germs.

R. E. Fitzpatrick

Viruses are so small that they are invisible through the ordinary microscope and are able to pass through certain special filters that will strain out ordinary bacteria and fungus spores. Because they are so very small we know little about most viruses, and much of our knowledge is gained, not from any study of the virus particles themselves, but from the way they behave—the diseases they cause and the way in which they are spread. However, with the establishment of a special unit at Vancouver to study the more fundamental aspects of virus structure and behavior, it is hoped that new techniques for the detection of viruses and the elimination of virus infection will be devised. A type collection of the commoner plant viruses will also be built up for reference and use by other research stations.

The great majority of plant viruses are named and defined on the basis of such characters as the types of plants they attack, the symptoms they cause on these plants, and the means by which they are spread from plant to plant. A common example will serve as an illustration. The tobacco plant in the accompanying illustration is infected with a virus that causes the leaves to be blotched with light and dark areas that form a sort of mosaic pattern. If we extract a little of the juice from this plant and rub it onto the leaf of a healthy plant, the new leaves of the healthy plant will, in a week or two, develop the same sort of pattern as the leaves of the infected plant. Moreover, since

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Dr. Fitzpatrick is a Plant Pathologist and is Director of the Department's Research Station at Vancouver, B.C.

we can go on repeating this process of infecting one plant from another indefinitely, it is obvious that the contagion causing the mosaic is in some way multiplying in the plant. This contagion we call the tobacco mosaic virus. However, although we call it the tobacco mosaic virus, its infectivity is not confined to the tobacco plant. This virus has a very wide host range, attacking plants of many different families. *Chenopodium amaranticolor,* a plant closely related to the common lamb's quarters, is one that is susceptible to tobacco mosaic virus, and an infected plant is shown in the illustration. In this case there is no trace of the mosaic pattern; the infection causes only localized dead spots. So not only will this virus infect different plants, but it will also produce symptoms other than mosaic on some.

On the other hand, we cannot infect the potato plant with the tobacco mosaic virus, although the potato is much more closely related to tobacco than is the *Chenopodium.* Yet the potato is susceptible to a number of viruses, some of which are easily transmitted to tobacco. The point is that it is possible to make some separation of the various viruses by studying the range of plants they attack and the effects they produce on these plants.

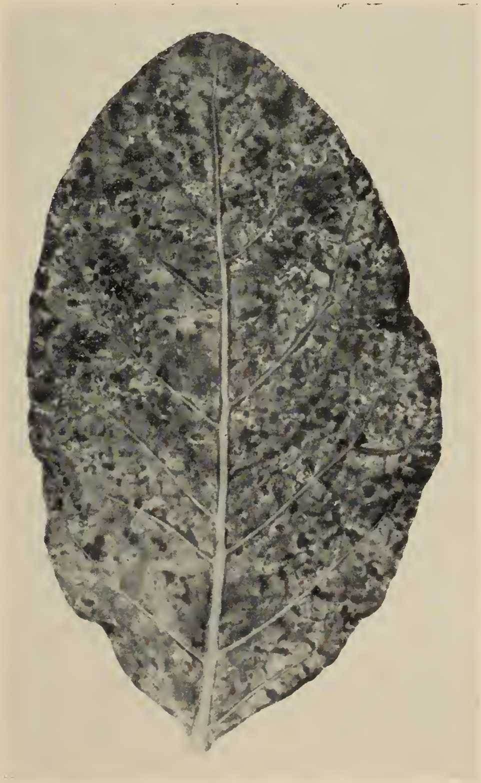
Further distinctions can be made by studying the methods by which the viruses are spread. Unlike tobacco mosaic virus, the majority of viruses are not easily transmitted by merely rubbing the juice from an infected plant onto a healthy one; in nature most of them are spread by insects such as aphids and leafhoppers.

There is always a specific relationship between the virus and the insect that spreads it, for while it is true that many viruses are carried by more than one insect species, those viruses that are carried by aphids are not spread by leafhoppers, and those that are carried by leafhoppers are not spread by aphids. Furthermore there are differences between viruses with respect to the length of time required for the feeding insect to become infective and the length of time it retains its infectivity.

PLANT VIRUS STUDY PROGRAM

Active programs of research on plant viruses are carried on at several stations of the Research Branch of the Canada Department of Agriculture. In Fredericton, the potato viruses have for many years received particular attention, and new potato varieties are tested for resistance to virus diseases. At Ottawa and Lethbridge the role of mites in the spread of wheat mosaic is being studied. The St. Catharines and Summerland Stations specialize in the fruit-tree viruses and a program for supplying virus-free bud wood to plant propagators is being developed. At Vancouver and Agassiz, where virus work on small fruits has been under way for several years, the same type of program has been started for strawberry stock.

Although our present knowledge of the majority of viruses is based on a study of the diseases they cause and the way in which they are spread, the invention of the electron microscope and the perfection of certain highly specialized physical and chemical techniques are beginning to lead us to a better understanding of what



Leaf of a tobacco plant infected with a virus that originally came from potato. This virus is known as the potato latent virus or potato virus-X.

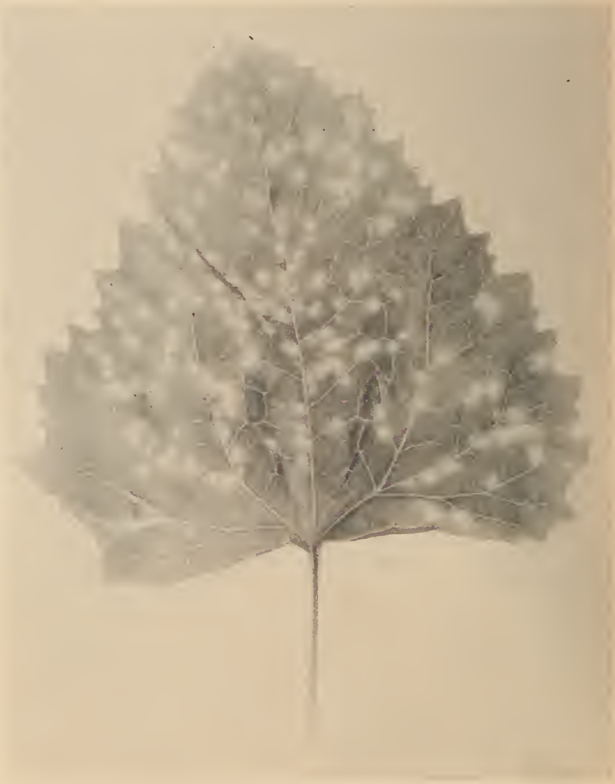
viruses are and how they behave in the plant cell. For instance, we now know that the tobacco mosaic virus is a rod-like particle about one eighty-thousandth of an inch long and less than a millionth of an inch across. The following example will show how small this really is. If we take a leaf that is about four inches long and magnify it, as a good electron microscope photograph would, to something in the neighborhood of 100,000 times, the leaf will become six and a quarter miles long. The cells of the leaf will be as large as, and some larger than, small houses. On this scale the tobacco mosaic virus particle will be about the size of a small match.

Unfortunately it is not possible to determine the size and shape of all the viruses with an electron microscope. This is because of the difficulty of distinguishing the virus particles from all the other particles found in the plant juice. We can be sure that the particles we see are actually virus only when we have a preparation that displays a fairly uniform type of particle, and when we can demonstrate that these are indeed infectious. This can be done only with viruses that are very stable and viruses that are rub-transmissible. To date good electron microscope pictures have been taken of only a dozen or so plant viruses. These pictures show that there are two main types, rod-shaped and spherical.

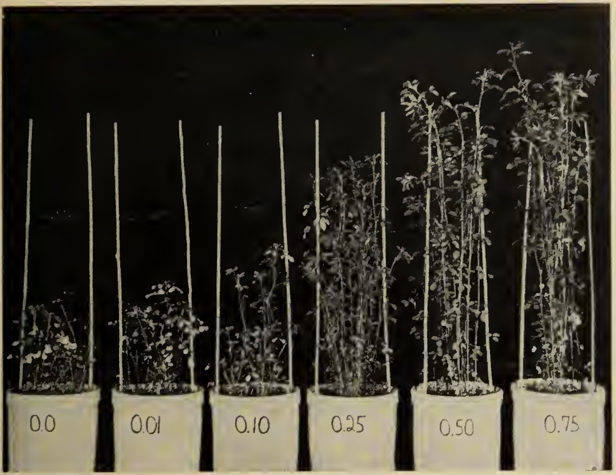
All viruses are extremely small and appear to be very simple structures, but chemically they are quite complicated. They are made up of only two types of material, proteins and nucleic acids, but both of these materials are very complex. Proteins are formed from simpler compounds known as amino acids. There are about two dozen different kinds of amino acids and even the simplest proteins are made up of several kinds. These amino acids are linked together to form long chains and the chains are twisted together and cross-linked to form the protein structure. The kinds of amino acids and their arrangement in the chains and the way in which the chains are put together determine the nature of the protein. The nucleic acids are also complicated structures. They consist of four basic units each joined by a special type of sugar molecule. These sugar molecules are linked together and again the structure is that of a long chain, the character of which is determined by the proportions and sequences of the four basic units.

In the tobacco mosaic virus particle the nucleic acid forms a core around which the protein material is wrapped. This protein material appears to protect the nucleic acid much as the wood of a pencil protects the lead. The nucleic acid seems to be the vital part of the virus, for it has been found that even if the protein sheath is removed, the naked nucleic acid of tobacco mosaic virus is capable of causing infection. The same thing has recently been shown to be true for another virus, the mild potato mottle virus (potato virus-X).

In virus infection what probably happens is this: when the virus particle enters the plant cell the protein sheath comes apart, releasing the nucleic acid. This material then affects the life processes of the cell in such a way that the cell begins to manufacture virus protein and virus nucleic acid in sufficient quantities for new virus particles to be formed. Exactly how these materials are brought together to form the completed virus particle is still unknown, but the new work has opened up exciting possibilities, for increasing our knowledge of the viruses, and of life itself.



Leaf of *Chenopodium amaranticolor* showing localized dead spots caused by the infection of tobacco mosaic virus.



Vue d'une expérience en serre destinée à étudier l'effet de diverses applications de borax sur la croissance de la luzerne. A noter que la luzerne du pot portant l'étiquette 0.25, quoique exempte de symptômes externes de carence de bore, ne semblait pas en mesure de donner des rendements maximums.

La Carence de Bore

Ses effets sur la culture de la luzerne

G.-J. Ouellette

LA MALADIE qu'on appelle communément "La jaunissure de la luzerne", et qui est due à une carence de bore assimilable dans le sol, a été notée et étudiée par de nombreux chercheurs. L'auteur lui-même a trouvé, au cours des années 1950 à 1954, qu'environ 50 p. 100 des luzernières de la province de Québec souffraient d'une carence en cet élément. De plus, 70 p. 100 des champs ainsi atteints étaient en sols sableux, 25 p. 100 en terres franches, et seulement 5 p. 100 en sols argileux et en terres noires. Cependant, l'importance agronomique de cette carence, en tant que facteur pouvant réduire la productivité et la longévité de la luzerne, n'a certes pas reçu l'attention qu'elle mérite. Il semble donc que la vulgarisation de quelques résultats expérimentaux obtenus sur le sujet serait de nature à jeter un peu de lumière sur le problème.

Longévité de la luzernière

Il peut sembler étonnant pour plusieurs que le bore, classé encore parmi les éléments mineurs, affecte la luzerne au point d'en diminuer la survie. Pourtant, un coup d'œil sur les résultats d'une expérience conduite de 1951 à 1955 sur le loam sableux St Pacôme indique qu'il en est bien ainsi. Le pourcentage de luzerne des parcelles témoins est tombé de 72 p. 100 à l'automne de 1951 à 32 p. 100 à l'automne de 1955. Par contre, dans les parcelles qui reçurent 25 livres de borax tous les ans, cette valeur est passée de 75 à 59 p. 100 pendant la même période. On voit donc qu'une carence de bore peut causer la mortalité de la luzerne dans une proportion assez élevée. Une telle mortalité, il va de soi, peut découler directement de la malnutrition, mais l'auteur croit qu'elle en constitue plutôt un effet indirect, en ce sens que la carence de bore prédispose la plante aux maladies et la rend moins résistante aux rigueurs de l'hiver.

Rendements en foin

S'il y a carence de bore dans un sol au point de causer des anomalies externes sur la plante, il doit nécessairement en résulter une diminution de la croissance de la plante. Or, dans l'expérience précitée, en loam sableux St Pacôme, des symptômes de carence de bore étaient visibles sur les parcelles témoins à chaque année, sauf en 1954, alors que la précipitation fut très abondante. Il ne faut donc pas se surprendre qu'une incorporation annuelle de 25 livres de borax ait causé une augmentation moyenne de rendements en foin de près d'une demi-tonne à l'acre. Prenant les parcelles témoins comme base de comparaison, ceci équivaut à une augmentation de 28 p. 100. Evidemment, ce pourcentage d'augmentation a varié avec les saisons, pour atteindre une valeur maximum de 37 en 1953 et une valeur minimum de 14 en 1954. Il est à remarquer que la carence de bore dans le sol est généralement plus prononcée lors des étés secs que lors des étés humides. Plusieurs théories ont été émises pour expliquer cet état de choses. La plus plausible est à l'effet que la luzerne doit, pour subvenir à ses besoins en eau en période de sécheresse, développer un système radiculaire plus profond; ceci l'oblige à se nourrir dans des horizons du sol où la quantité de bore assimilable est généralement très limitée.

L'augmentation de 14 p. 100 obtenue en 1954 s'est révélée significative à l'analyse statistique. Pourtant, aucun symptôme visible de carence de bore n'a pu être observé pendant cette saison. Ceci semble indiquer que la manifestation des symptômes externes, du moins sur la luzerne, constitue un état avancé de carence de bore, et que l'addition de cet élément peut causer des augmentations de rendements dans des champs où ces symptômes ne sont pas encore apparents. D'ailleurs, cette hypothèse a été confirmée par une expé-

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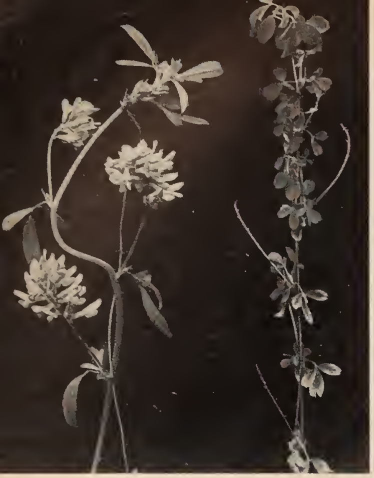
Dr G.-J. Ouellette, de la Ferme Expérimentale de Ste-Anne-de-la-Pocatière, est spécialisé en fertilité des sols, plus particulièrement dans le domaine des oligo-éléments.



Effets du borax sur la floraison de la luzerne. ***A gauche:*** **luzerne provenant de parcelles bien pourvues de borax.** ***A droite:*** **luzerne provenant de parcelles témoins. A noter l'absence de bourgeons et la tombée prématurée des fleurs dans ce dernier cas.**

rience en serre où l'auteur avait pour but d'étudier le comportement de la luzerne dans des solutions nutritives contenant diverses quantités de bore. Quoiqu'aucun symptôme de carence ne put être observé dans les pots ayant reçu 0.25 partie par million de bore, la croissance de la luzerne y fut beaucoup moins considérable que dans ceux qui contenaient de plus grandes quantités de cet élément, soit 0.50 et 0.75 partie par million. Avec 0.25 partie par million de bore, les rendements furent de 56.8 grammes par pot, alors qu'ils furent de 74.1 et 73.7 grammes respectivement avec 0.50 et 0.75 partie par million.

Protéine et qualité du fourrage

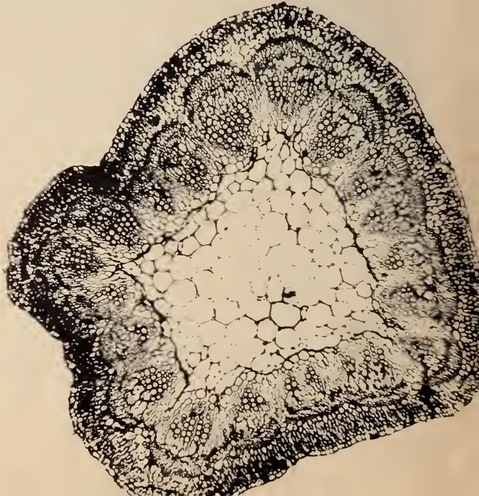
Tout comme la matière sèche, la protéine a augmenté grâce aux applications de borax, mais dans des proportions encore plus élevées. C'est ainsi que les parcelles qui recevaient 25 livres de borax chaque printemps ont donné 705 livres de protéine par année au cours de la période 1952-55, alors que les parcelles témoins n'en donnaient que 482 livres, ce qui équivaut à une augmentation de 46 p. 100. Cette augmentation très marquée des rendements en protéine résulte du double fait que les rendements en matière sèche et le pourcentage de luzerne dans la flore ont été favorablement influencés par l'addition de bore au sol. Si on admet que le pourcentage de protéine constitue un indice de la qualité d'un fourrage, il faut conclure qu'une carence de bore peut affecter de façon très marquée la qualité d'un foin de luzerne, tout autant, sinon plus, que sa quantité.

Production de graine

Les anomalies histologiques d'une carence de bore sur la luzerne s'observent surtout dans les tissus méristématiques, lesquels forment une partie importante des bourgeons terminaux et latéraux. Il ne faut donc pas se surprendre de compter au nombre des symptômes externes de carence de bore l'avortement des bourgeons florifères. Bien plus, l'auteur a observé que même si les bourgeons n'avortent pas et que les fleurs réussissent à ouvrir, leurs organes de reproduction sont très souvent malformés, ce qui empêche la pollinisation normale et la production de graines. Avec une application annuelle de 25 livres de borax, les rendements en graine de luzerne sont passés de 46 livres qu'ils étaient sur les parcelles témoins à 141 livres. Ceci correspond à une augmentation de 207 p. 100. De plus, les graines récoltées sur les parcelles traitées au borax étaient de qualité supérieure aux autres, en ce sens qu'elles étaient généralement plus grosses et mieux remplies. L'addition de borax à un autre type de sol également sableux de la région de Ste-Anne-de-la-Pocatière a causé une augmentation de 359 p. 100 dans la production de la graine de luzerne en 1956. L'on voit donc qu'il est inutile de songer à produire de la graine de luzerne sur les sols légers du Québec sans y appliquer des quantités suffisantes de borax.

Recommandations

Il semble bien que la production de graine de luzerne requiert des quantités plus élevées de bore que la production du foin. De plus, il a été prouvé que, du moins sous le climat de la province de Québec, le borax est lavé plutôt rapidement dans les sols légers, au point de n'y durer guère plus de deux ans. Ce phénomène rend donc nécessaire l'addition fréquente de quantités plutôt réduites de borax au sol. Il est à noter, cependant, que l'action du broax est de durée plus longue dans les sols lourds. Pour assurer à la luzerne une survie convenable et en obtenir de bons rendements dans les sols dépourvus de bore, il convient donc de recommander des applications bisannuelles de 10 à 20 livres de borax à l'acre pour la production du foin, et de 20 à 25 livres pour la production de la graine. Pour cette dernière production, et dans le cas de carence très prononcée, il y aurait peut-être avantage à renouveler l'application tous les ans. A noter qu'une application de borax supérieure à 20 livres à l'acre peut être toxique à la plante-abri, l'avoine en particulier, si elle est faite au temps du semis de cette dernière. Dans ce cas, on conseille de retarder l'application du borax au printemps de la première année de foin.



Section transversale d'une jeune tige de luzerne souffrant de carence de bore. A noter l'hypertrophie et l'accumulation de tissus brisés dans la région cambium-liber, de même que la désintégration des cellules de la moelle adjacentes aux faisceaux vasculaires.

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